

REMARKS

Claims 1-20 are currently pending in the application. In the Office Action dated September 14, 2005 ("Office Action"), the Examiner rejected claims 1 and 14 under 35 U.S.C. §103(a) as being unpatentable over Otterness et al., U.S. Patent No. 6,654,831 B1 ("Otterness") in view of LeCrone et al., U.S. Patent No. 6,308,284 B1 ("LeCrone") and McCabe et al., U.S. Patent Publication No. US 2005/0027892 A1 ("McCabe"), allowed claims 15-20, and indicated conditional allowance of claims 2-13, objected to as being dependent upon a rejected base claim, but allowable if rewritten in independent form.

Applicant's representative again thanks the Examiner for the conditional allowance of claims 2-13 and for allowing claims 15-20. However, Applicant wishes to continue pursuing claim 1, as previously amended by Applicant's representative.

Applicant's representative's arguments are quite brief. The Examiner states, in the Office Action, that Otterness and LeCrone do not disclose including a unified sequence number component with the data in the first storage component. Applicant's representative agrees with this statement. The Examiner then cites McCabe as disclosing the use of sequence numbers to ensure data consistency for remote mirroring operations, and further claims that McCabe's sequence numbers are functionally equivalent to Applicant's unified sequence number component. Applicant's representative does not agree with this latter statement.

The Examiner cites only a single paragraph of McCabe, and that paragraph contains only a single relevant sentence: "Sequence numbers and/or timestamps may also be used, since packetized data does not necessarily arrive at the destination in the same order it was sent." Indeed, use of sequence numbers and/or timestamps for ordering packets transmitted from a single source to one or more destinations is quite well known in many fields of computing and electronics, and that is exactly how McCabe uses timestamps and/or sequence numbers. But such use of timestamps or sequences is well known to be inadequate in multi-source situations, as described in the current application beginning on line 26 of page 10. Instead, the claimed data-consistent, distributed unified data set device group employs a unified sequence number component, as described in the current application with reference to Figure 7:

Figure 7 illustrates a direct communications link and a USN component added to the hardware configuration shown in Figure 6 in order to provide for data consistency between the IUDSDG and a mirror UDSDG. The added direct, vertical communications link 702 links the disk array controller 704 of local disk array 604b to the disk array controller 706 of local disk array 604a. In the system shown in Figure 7, disk array 604a is designated the supervisor and disk array 604b is designated the subordinate with respect to an IUDSDG 602a-b distributed over disks of local disk arrays 604a-b. A USN component 708 has been added to the disk array controller 706 functionality of the supervisor. Both the subordinate and supervisor disk arrays cooperate by using the USN component 708 to serialize or partially serialize WRITE requests related to the IUDSDG 602a-b generated by the subordinate and supervisor disk arrays 602a-b and directed to the remote disk array 608 that contains the corresponding mirror UDSDG 606. When the controller of either the subordinate or supervisor disk arrays is ready to issue a WRITE request to the mirror UDSDG 606, the controllers first access the USN component 708 to obtain a USN for the WRITE request.

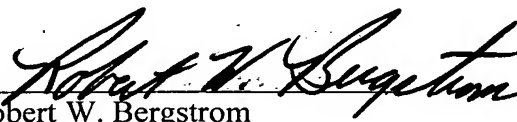
For UDSDGs operating in synchronous mode, the USN component 708 allows only a single USN-associated WRITE request to be pending at any given time, and thus WRITE requests directed to the mirror UDSDG are essentially single threaded through the USN component 708. By serializing the WRITE requests directed to the mirror UDSDG 606, the USN component 708 ensures that the data stored within the mirror UDSDG is consistent with the data state of the IUDSDG distributed between the local disk arrays. Serialization ensures that WRITE requests are not executed against the mirror UDSDG out of order, and no WRITE request is omitted from a sequence of WRITE requests. Thus, the above described problems illustrated using the relational DBMS example are prevented by WRITE request serialization. For UDSDGs operating in asynchronous mode, by contrast, the USN component 708 allows a number of USN-associated WRITE requests, up to some maximum number, to be pending for a particular UDSDG at any given time, and thus WRITE requests directed to the mirror UDSDG are partially serialized. By partially serializing the WRITE requests directed to the mirror UDSDG 606, the USN component 708 ensures that the data states of the UDSDG and mirror UDSDG do not diverge by more than some acceptable level of data state divergence. Synchronous mirroring mode provides for a more up to date fail-over in the event of local UDSDG fail-over, but at the expense of single threading WRITE requests. Asynchronous mirroring mode requires either data check pointing, e.g. via sequence numbering, or a more complex fail-over mechanism, but also provides for greater performance and throughput by not strictly single threading WRITE request execution.

The USN serializes WRITE requests generated by two different WRITE-request generating entities, namely two different disk arrays. The unified sequence number component is clearly not simply a timestamp or sequence number. It is a hardware component that serializes WRITE requests from two, concurrently operating disk arrays. The claimed unified sequence number component is not taught, mentioned, or suggested in the

single sentence of McCabe cited by the Examiner. For this reason, the Examiner's obviousness-type rejection of claims 1 and 14 must fail, since neither Otterness nor LeCrone, as acknowledged by the Examiner, teach, mention, or suggest the claimed unified sequence number component.

In Applicant's representative's opinion, all of the claims remaining in the current application are clearly allowable. Favorable consideration and a Notice of Allowance are earnestly solicited.

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